

A new species of *Paralamyctes* (Chilopoda: Lithobiomorpha) from New Zealand

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Abstract

Paralamyctes (*Paralamyctes*) *rahuensis* n. sp. is endemic to the Buller area of South Island, New Zealand. Cladistic analysis of morphological characters indicates closest relations to *P. (P.) harrisi* Archey, 1922, from North Island, and *P. (P.) monteithi* Edgecombe, 2001, from Queensland, Australia.

Key words: Chilopoda, Lithobiomorpha, Henicopidae, *Paralamyctes*, *Paralamyctes rahuensis*, New Zealand

Introduction

The lithobiomorph centipede *Paralamyctes* Pocock, 1901, has a temperate circum-Gondwanan distribution. Species are known from southern Africa, Madagascar, southern India, Patagonian Argentina and Chile, eastern Australia, and New Zealand. Most species have been the subjects of recent taxonomic descriptions or revisions (Edgecombe 2001, 2003a, b, 2004). A large molecular character set is also available, including data from five markers (Edgecombe et al. 2002; Edgecombe & Giribet 2003a), with the taxonomic sample spanning most species throughout the range of the genus.

Descriptive work on the Henicopidae of New Zealand was undertaken by Gilbert Archey in a series of papers between 1917 and 1937 (Archey 1917, 1921, 1922, 1937). New Zealand species of *Paralamyctes* include *P. (Paralamyctes) harrisi* Archey, 1922, from North Island, *P. (Thingathinga) validus* Archey, 1917, from North and South Islands, *P. (Haasiella) halli* (Archey, 1917), from South Island, and *P. (Haasiella) trailli* (Archey, 1917), from South and Stewart Islands. A species of *P. (Paralamyctes)* described herein from the Buller area of South Island is the first new lithobiomorph to be discovered in New Zealand in more than 80 years.

Specimens cited herein are housed in the Canterbury Museum, Christchurch (abbreviated CMNZ). Scanning electron microscopy used a LEO 435VP with a Robinson back-scatter collector.

Taxonomy

Paralamyctes Pocock, 1901

Type species: Paralamyctes spenceri Pocock, 1901.

Assigned species: See Edgecombe (2003a: 113–115), with key.

Diagnosis: Henicopini with large, bell-shaped sternite on first maxilla bordered by unsclerotised inner edge of coxa; suture between coxa and sternite confined to a narrow contact at posterior edge of maxilla; coxa separate in front of sternite, median suture lacking. Median furrow on head shield well impressed, continuous to transverse suture.

Paralamyctes (Paralamyctes) Pocock, 1901

Diagnosis: *Paralamyctes* with mandibular aciculae bearing elongate pinnules along dorsal side of acicula only; accessory denticle field intergrading with furry pad; antenna with relatively few (typically 17–20) elongate, tubular articles; articulations between tarsomeres strong; longitudinal median furrow on sternites well defined.

Paralamyctes (Paralamyctes) rahuensis n. sp.

Figs. 1–31

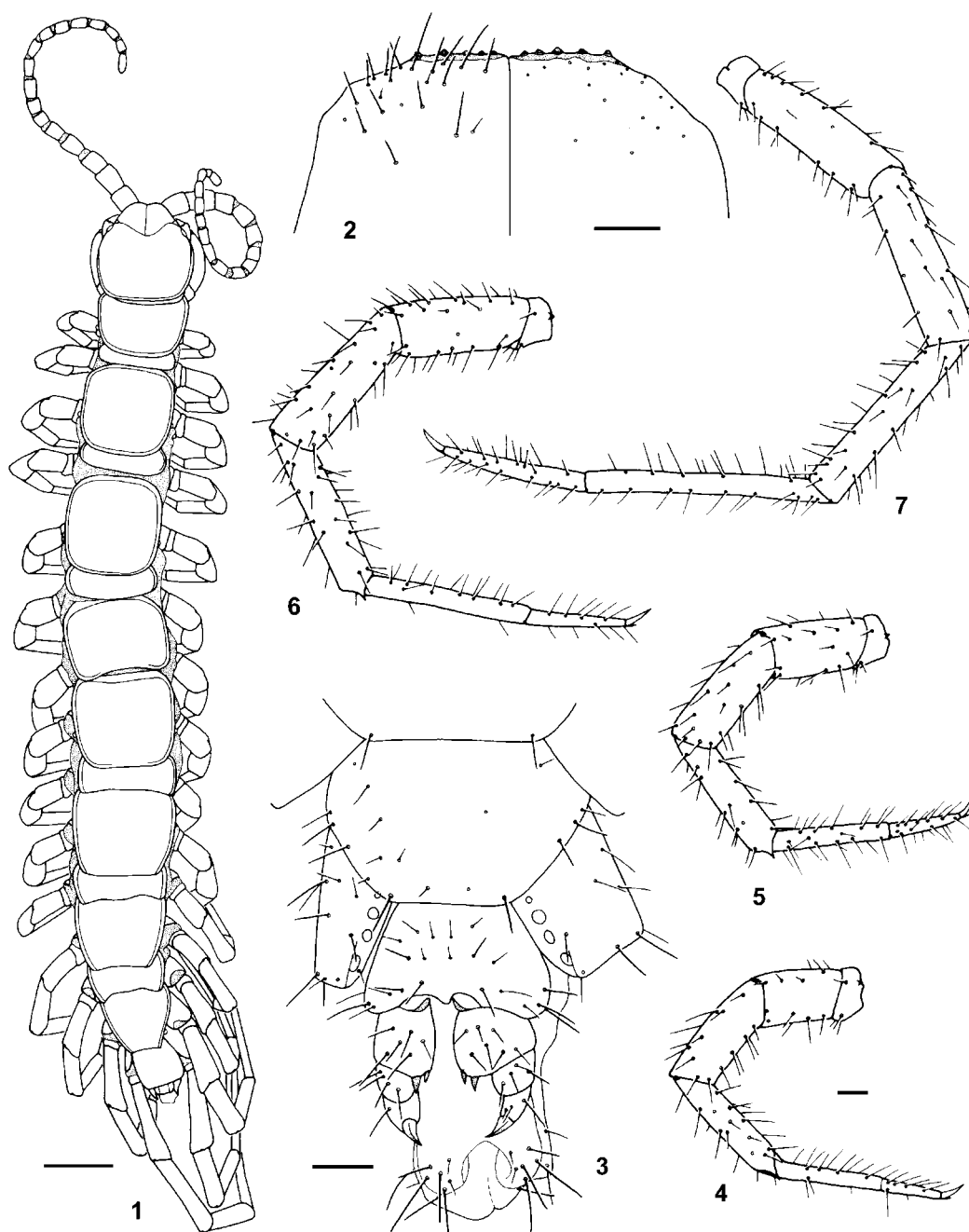
Diagnosis: *P. (Paralamyctes)* with 17–20 antennal articles; 4+4 to 5+5 teeth on dental margin of maxillipede coxosternum, each half of dental margin nearly transverse; few (3–6) apical setae on coxal process of first maxilla; band of 6–7 setae on each coxa of second maxilla; branching bristles on mandible with abundant slender hairs; distal spinose projections on tibia of legs 1–14; posterior margins of sternites lacking setae except for seta at posterolateral corner; female gonopod with pair of small, conical spurs.

Holotype: CMNZ 2004.19.1, female (Fig. 1), Rahu Scenic Reserve, 2.5 km W of Springs Junction, South Island, New Zealand, 42°19'56.1"S 172°10'16.6"E, 437 m, 31 January 2003, S. Boyer, C. D'Haese & G. Giribet, closed *Nothofagus* forest.

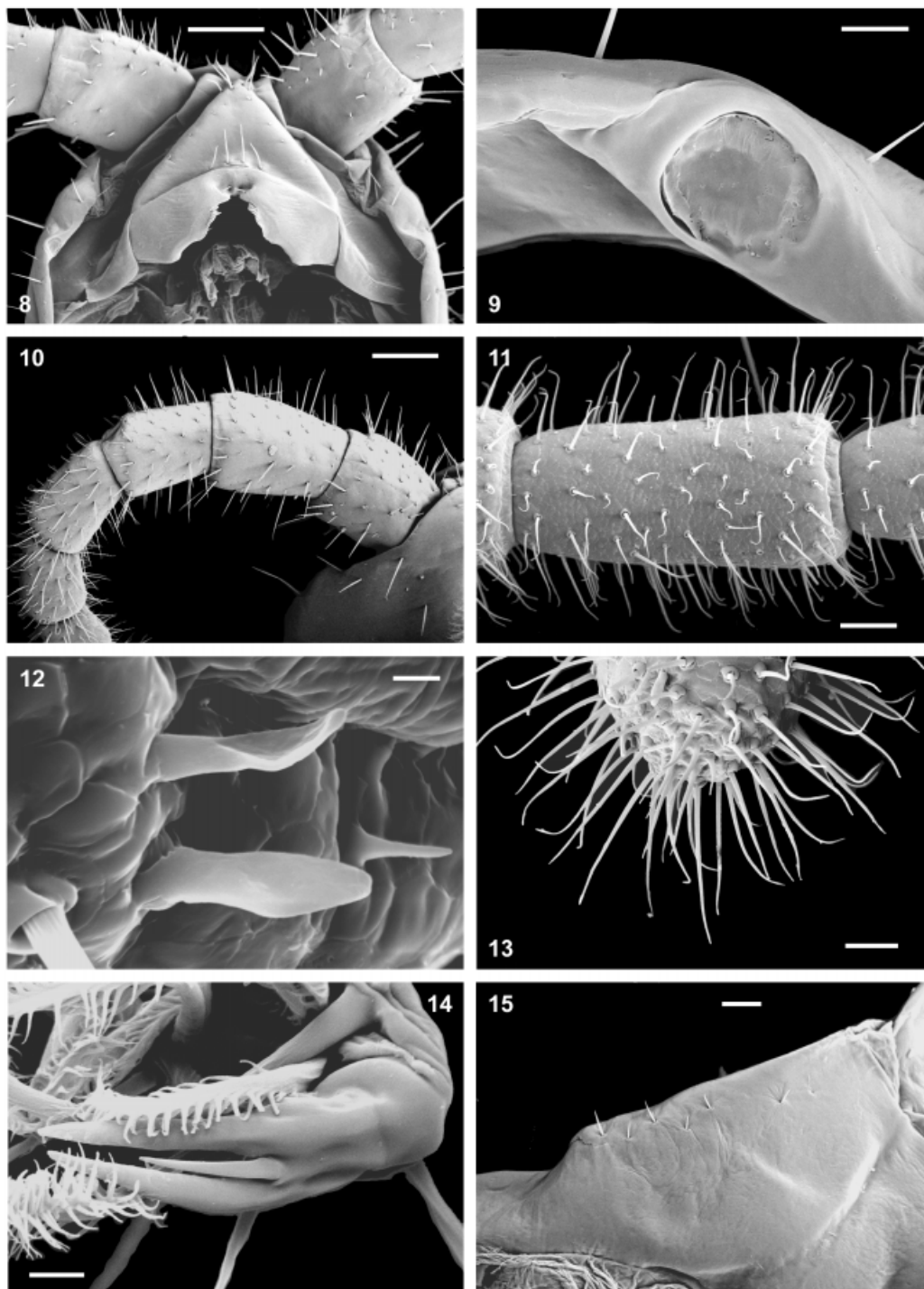
Paratypes: CMNZ 2004.19.2, female (Figs. 3–19, 24, 27–30), from type locality, same collection; CMNZ 2004.19.3 (Figs. 23, 25, 26, 31)–2004.19.5, 3 females, from type locality, 3 February 2004, G.D. Edgecombe & Z. Johanson; CMNZ 2004.19.6, female (Figs. 2, 20–22), Reefton Saddle, 14 November 1974, P.M. Johns.

Etymology: For Rahu Scenic Reserve, the type locality.

Description: Length of body (anterior margin of head shield to posterior end of telson) up to 20 mm; length of head shield up to 1.9 mm.



FIGURES 1–7. *Paralamyctes (Paralamyctes) rahuensis* n. sp. 1, holotype CMNZ 2004.19.1, female, scale 1 mm. 2, CMNZ 2004.19.6, female, dental margin of maxillipede coxosternum, scale 200 µm. 3–7, CMNZ 2004.19.3, female, scales 200 µm. 3, posterior segments and gonopods; 4, leg 12; 5, leg 13; 6, leg 14; 7, leg 15.



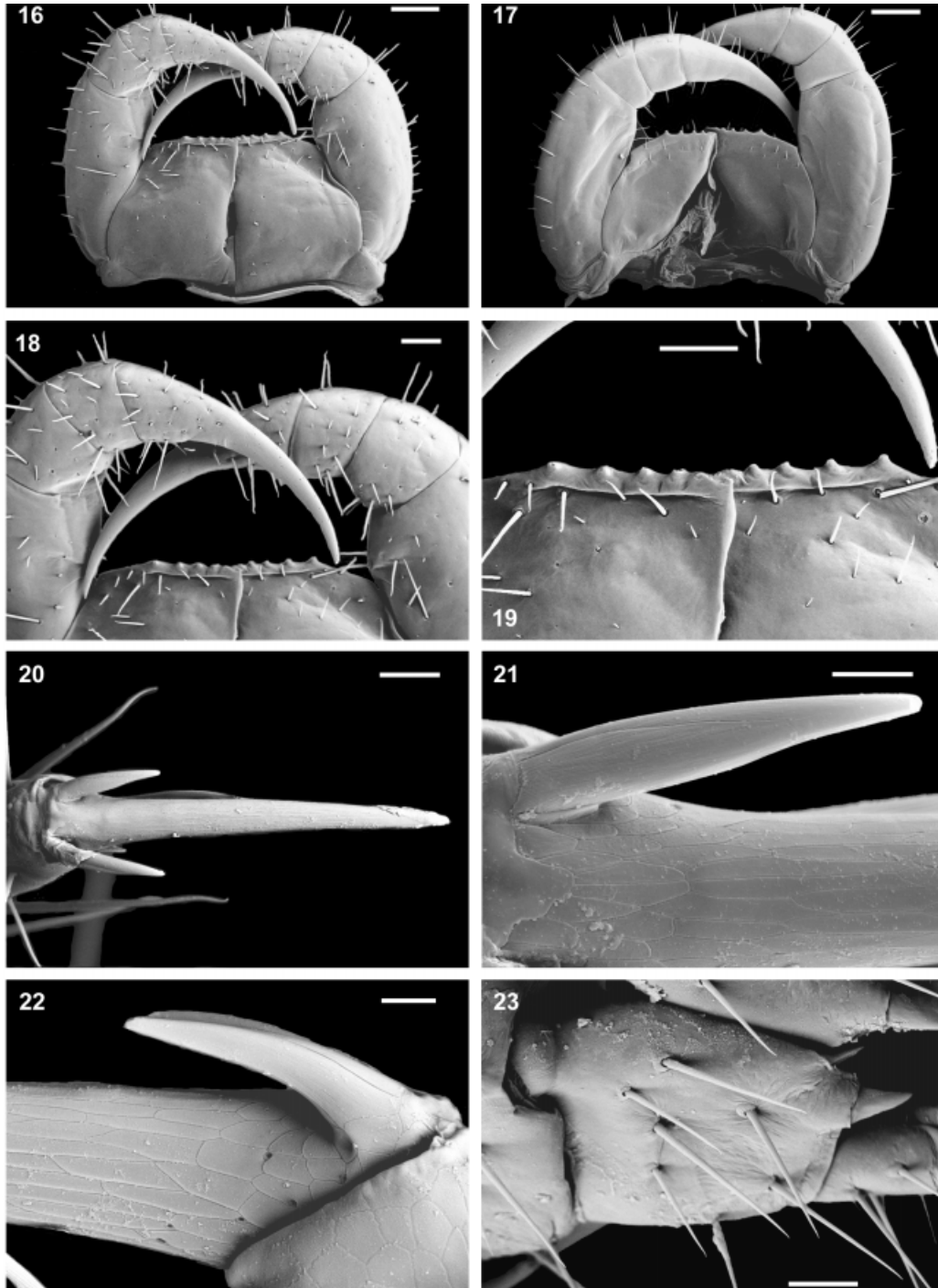
FIGURES 8–15. *Paralamyctes (Paralamyctes) rahuensis* n. sp. CMNZ 2004.19.2, female. 8, ventral view of head, scale 200 µm; 9, Tömösváry organ, scale 20 µm; 10, proximal part of left antenna, scale 200 µm; 11, dorsal side of article 10, right antenna, scale 50 µm; 12, pair of basiconic sensilla on dorsal side of article 14, right antenna, scale 3 µm; 13, tip of antenna, scale 20 µm; 14, claw of second maxilla, scale 10 µm; 15, coxa of second maxilla, scale 40 µm.

Colour (based on specimens in absolute ethanol): antenna and maxillipede pale orange; head shield yellow/pale orange with purple/brown mottled network; tergites drab yellow with purple longitudinal median band, paler purple mottled bands laterally on TT1–5; legs pale yellow on trochanter and prefemur, purple tinge on femur and tibia, orange on tarsus.

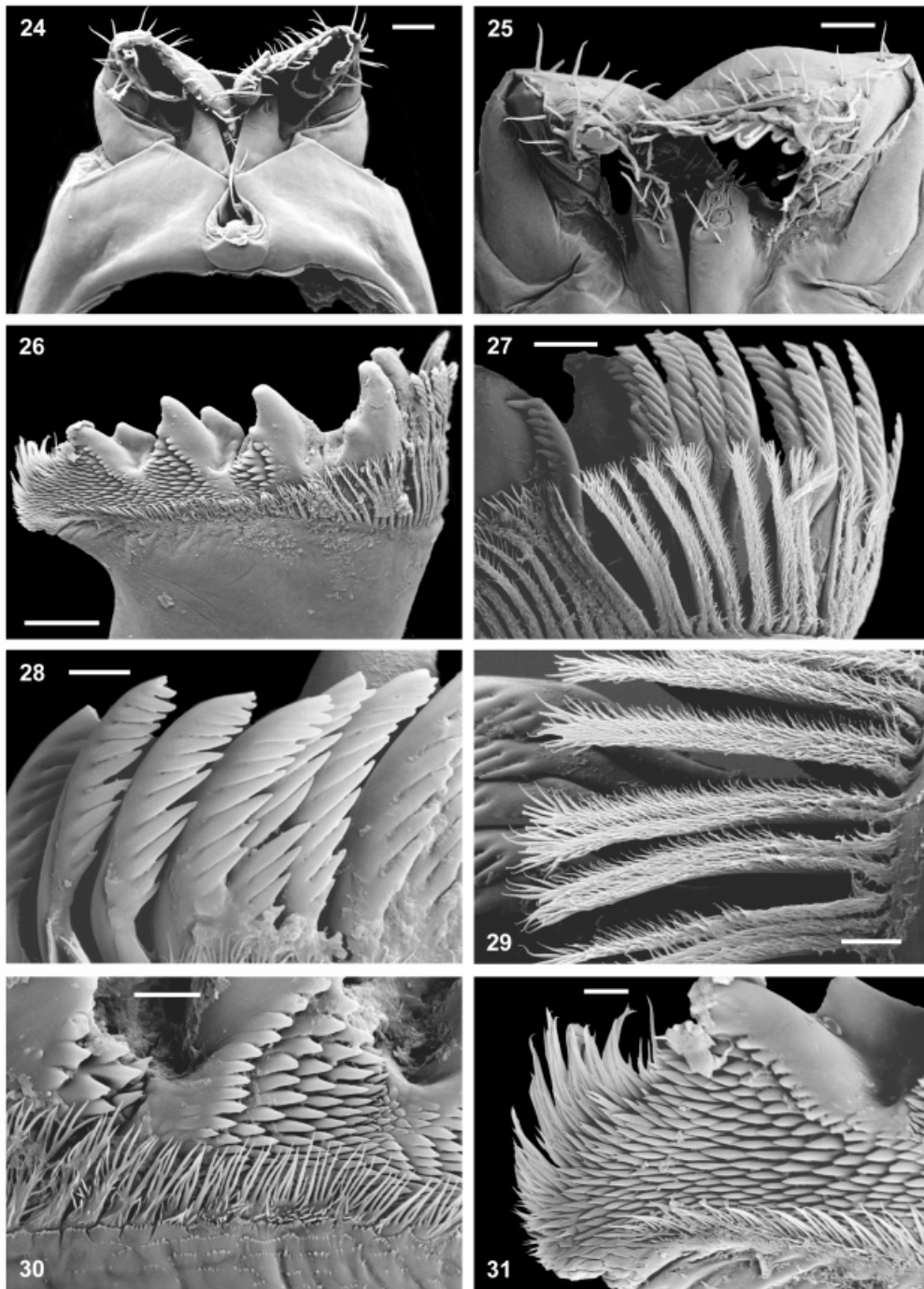
Head shield smooth, 93–100% width of widest tergite (T10). Anterior margin with moderately strong median notch; longitudinal median furrow impressed to transverse suture. Posterior margin of head shield transverse or weakly concave. Antenna 3–3.4 times length of head shield, with 17 (N=5: Rahu Scenic Reserve) or 20 (N=1: Reefton Saddle) articles. Basal two articles moderately larger than succeeding few (Fig. 10); all articles longer than wide, nearly all considerably so, including numerous tubular articles twice as long as wide with trichoid sensilla arranged in 10 or 11 imprecisely-arranged whorls (Fig. 11). Single clavate or slightly spatulate thin-walled basiconic sensillum on outer dorsal margin at anterior edge of each of articles 3–16 in specimen with 17 articles, exceptionally a pair of sensilla (Fig. 12); single similar basiconic sensillum near apex of terminal article on its dorsal side, just behind cluster of apical sensilla brachyconica (Fig. 13). Ocellus domed, with lavender pigment. Tömösváry organ moderately large, relatively strongly recessed, at anterior edge of cephalic pleurite on ventral margin of head (Fig. 9). Clypeus with band of four or six setae medially just in front of labrum (Fig. 8). Labral margin redirected backwards against fringe of branching bristles; fringe dense, each bristle with many short, slender, hair-like branches along its length.

Maxillipede: coxosternum broadly subquadrate (Fig. 16); each dental margin nearly straight, transverse across dentate extent (inner two-thirds), then gently sloping backwards distally; teeth small, blunt, of equal size or with smaller (sometimes minute) inner tooth, 4+4 (N=1), 5+4 (N=1) or 5+5 (N=4); median notch absent (Fig. 19). Coxosternum moderately setose, with majority of setae concentrated anterolaterally (Fig. 2). Pretarsal part of tarsungulum 1.6–1.8 times length of tarsal part; inner margin of tarsungulum, tibia and femur with a few setae longer than those on outer and ventral sides but with similar density of setation (Fig. 18).

Mandible: four paired teeth (Fig. 26). 10–11 aciculae; 9–13 stout pinnules with pointed tips aligned against each other on distal half on dorsal side of each acicula (Figs. 27, 28). Fringe of branching bristles with slender ventral bristles, densely covered with slender hair-like branchings to their bases (Fig. 29); each bristle terminates with a row of slender branches that are about twice as thick and distinctly longer than all others; fringe grades dorsally into progressively narrower band of bristles that tapers out near furry pad (Fig. 31). Dorsal three teeth with grooved ridge bounded by a row of strong, triangular accessory denticles (Fig. 30); remainder of accessory denticles likewise angular, becoming smaller and more slender towards bases of teeth; accessory denticles near furry pad elongate, distally bifurcate; furry pad a dense cluster of mostly simple, elongate bristles (Fig. 31).



FIGURES 16–23. *Paralamyctes (Paralamyctes) rahuensis* n. sp. 16–19, CMNZ 2004.19.2, female. 16, 17, ventral and dorsal views of maxillipedes, scales 200 μ m; 18, maxilliped telopodites, scale 100 μ m; 19, dental margin of maxilliped coxosternum, scale 100 μ m. 20–22, CMNZ 2004.19.6, female, leg 14. 20, dorsal view of pretarsus, scale 30 μ m; 21, 22, dorsal and anterior views of anterior accessory claw, scales 10 μ m. 23, CMNZ 2004.19.3, female, basal article of gonopod, scale 50 μ m.



FIGURES 24–31. *Paralamyctes (Paralamyctes) rahuensis* n. sp. 24, 27–30, CMNZ 2004.19.2, female. 24, first maxillae, scale 50 μ m; 27, 29, right mandible, ventral part of gnathal edge and fringe of branching bristles, scales 20 μ m, 10 μ m; 28, 30, left mandible. 28, aciculae, scale 10 μ m; 30, fringe of branching bristles and accessory denticles on teeth, scale 15 μ m. 25, 26, 31, CMNZ 2004.19.3, female. 25, coxal processes and telopodites of first maxillae, scale 50 μ m; 26, 31, right mandible, gnathal edge, and dorsal tooth and furry pad, scales 50 μ m, 10 μ m.

First maxilla: large, bell-shaped sternite set in arthrodial membrane, as typical of genus (Fig. 24). Apex of coxal process bearing three to six simple setae (Fig. 25). Distal article of telopodite with numerous paired plumose bristles along inner margin; row of shorter simple setae near bases of plumose bristles; several (approximately seven) simple setae scattered on rest of ventral surface of distal article.

Second maxilla: Anterior margin of coxa straight; band of six or seven setae across anterior part of coxa (Fig. 15). Approximately 12 plumose setae on inner surface of tarsus. Claw composed of five digits, median and outer pair long, thick, these separated by a digit about half as thick and two-thirds as long (Fig. 14).

Tergites gently wrinkled; T1 90–95% width of head shield, trapezoidal (Fig. 1); TT3 and 5 with parallel lateral margins, posterior angles rounded; posterior margins of TT1, 3 and 5 transverse (T5 variably gently concave); posterior margin of T7 concave, without angular ‘notch’, posterior angle slightly projected; posterior margins of TT8 and 10 transverse or faintly concave; posterior margin of T12 gently concave; posterior angle of T8 rounded, TT10 and 12 form obtuse, blunt corners; posteromedian margin of T9 transverse, lateral part flexed backwards to form a weak projection; posteromedian margin of TT11 and 13 gently convex, lateral parts flexed backwards as short projections, without teeth; posterior margin of T14 gently concave, with sharp posterior angles lacking projection; posterior margin of tergite of intermediate segment transverse in female, with rounded posterior angle. Tergites of first genital segment and telson well sclerotised in female but only lightly pigmented.

Several fine, short to moderately long setae along lateral borders of tergites; a few scattered setae on anterior part of tergites and all over TT12 and 14; 10 or 12 setae across posterior margins of TT11–13. Sternites with band of six setae across anterior third; four or five setae along lateral margins of sternites, including one at posterolateral corner; additional setae lacking along posterior sternal margins. Longitudinal median furrow on anterior half of sternites.

Lengths of legs 12–15 with the ratios 1: 1.1: 1.4: 1.8 (Figs. 4–7). Joint between two tarsomeres fairly strong on legs 1–12, more pronounced on legs 13–15. Strong distal spinose projections of tibia of legs 1–14, lacking on leg 15. Leg 15 distitarsus 60–65% length of basitarsus; basitarsus 10–12 times longer than maximal width (Fig. 7). Coarsest setae on tarsus of legs 1–13 only slightly finer than those on prefemur-tibia; basitarsus variably more sparsely setose than distitarsus on legs 14–15. Anterior and posterior accessory claws on all legs, both based on the dorsolateral side of main claw (Fig. 22), nearly equal in size, gently divergent (Fig. 20). One large scute along most of length of accessory claw on its dorsal side; entire surface of accessory claws ornamented with narrow ridges and grooves (Fig. 21). Scutes well defined along length of main claw, including its proximo-dorsal surface (Fig. 21). Posteroventral spine relatively short, about 10% length of main claw; subsidiary spine at its base more than one-third length of posteroventral spine. About six rimmed pores at margins of scutes on anterior and posterior sides of main claw beneath

the accessory claws (Fig. 22).

4,4,4,4/4,4,4,4 or 4,5,4,5/4,4,4,5 coxal pores in female, all round, inner pore smallest (Fig. 3). Coxal pore row set off from rest of coxa by a sharp fold against outer pore, grading into a rounded curve against more proximal pores.

Female (Fig. 3): Sternite of segment 15 with transverse posteromedial margin. First genital sternite with 10–12 setae in front of posterior margin, two rows of short setae across its width near midlength. Gonopod with 6–13 setae on basal article (Fig. 23), four on second article, one or two large setae on third as well as one or two small setae on ventromedial side. Spurs small, conical, evenly tapering to a blunt point; inner spur varying from slightly shorter and narrower than outer spur to as little as half width and two-thirds length of outer spur. Claw small, entire.

Discussion: All six known specimens of *Paralamyctes* (*Paralamyctes*) *rahuensis* are females. A larger sample size is required to test the possibility of parthenogenesis, as has been documented in some species of *Lamyctes* (Enghoff 1975; Edgecombe & Giribet 2003b).

Paralamyctes rahuensis is most similar to *P. (Paralamyctes) harrisi* Archey, 1922, from North Island, New Zealand, and *P. (Paralamyctes) monteithi* Edgecombe, 2001, from Queensland, Australia. All of these species, as well as *P. (Paralamyctes) tridens* Lawrence, 1960, from Madagascar, share a positioning of the Tömösváry organ on the ventral margin of the head (Figs. 8, 9) that is unique to this group. To test the phylogenetic status of this and other characters, morphological characters that vary within *Paralamyctes* and outgroup Henicopini were extracted from a published dataset (Edgecombe 2003c). Of 57 characters used for higher-level systematics of Henicopidae, 33 are informative for *Paralamyctes* and the selected outgroups, two species of each of *Henicops* and *Lamyctes* (Appendix and Table 1). One new character (character 28 in Table 1) was added here. All other characters are documented in previous studies (Edgecombe 2003c, 2004). Multistate characters are unordered. Parsimony analysis of the morphological data was executed with PAUP* version 4.0b10 (Swofford 2002). A heuristic search used 1000 random stepwise addition replicates and TBR (Tree Bisection and Reconnection) branch swapping, retaining up to 10 trees per replicate, then swapping on those trees to completion. Support for nodes was quantified by parsimony jackknifing (Farris et al. 1996), with 1000 replicates having 33% character deletion. Bremer support (Bremer 1994) was computed by the ‘enforce converse constraints’ command in PAUP*, using MacClade version 4.0 (Maddison & Maddison 2000) to generate the PAUP* command file with converse constraints.

Analysis of the data yielded 12 shortest cladograms of 66 steps (Consistency Index 0.62; Retention Index 0.80; Rescaled Consistency Index 0.49). The strict consensus of these cladograms is shown in Fig. 32. Within *Paralamyctes*, the subgenera *Nothofagobius*, *Paralamyctes* and *Thingathinga* each form monophyletic groups, all with jackknife frequencies above 75% and Bremer support of 2 or more. *Paralamyctes* (*Haasiella*) sensu Edgecombe (2004) is variably either monophyletic or paraphyletic with respect to *P.*

(*Thingathinga*); monophyly of *P. (Haasiella)* is found in 51% of jackknife replicates. The 12 cladograms differ in variable interrelationships of two species from southern Africa, *P. (Paralamyctes) prendinii* and *P. (P.) spenceri*, which are variably allied either with other species from South Africa (clade composed of *P. weberi*, *P. asperulus* and *P. levigatus*) or to a Malagasy-Australasian clade discussed below.

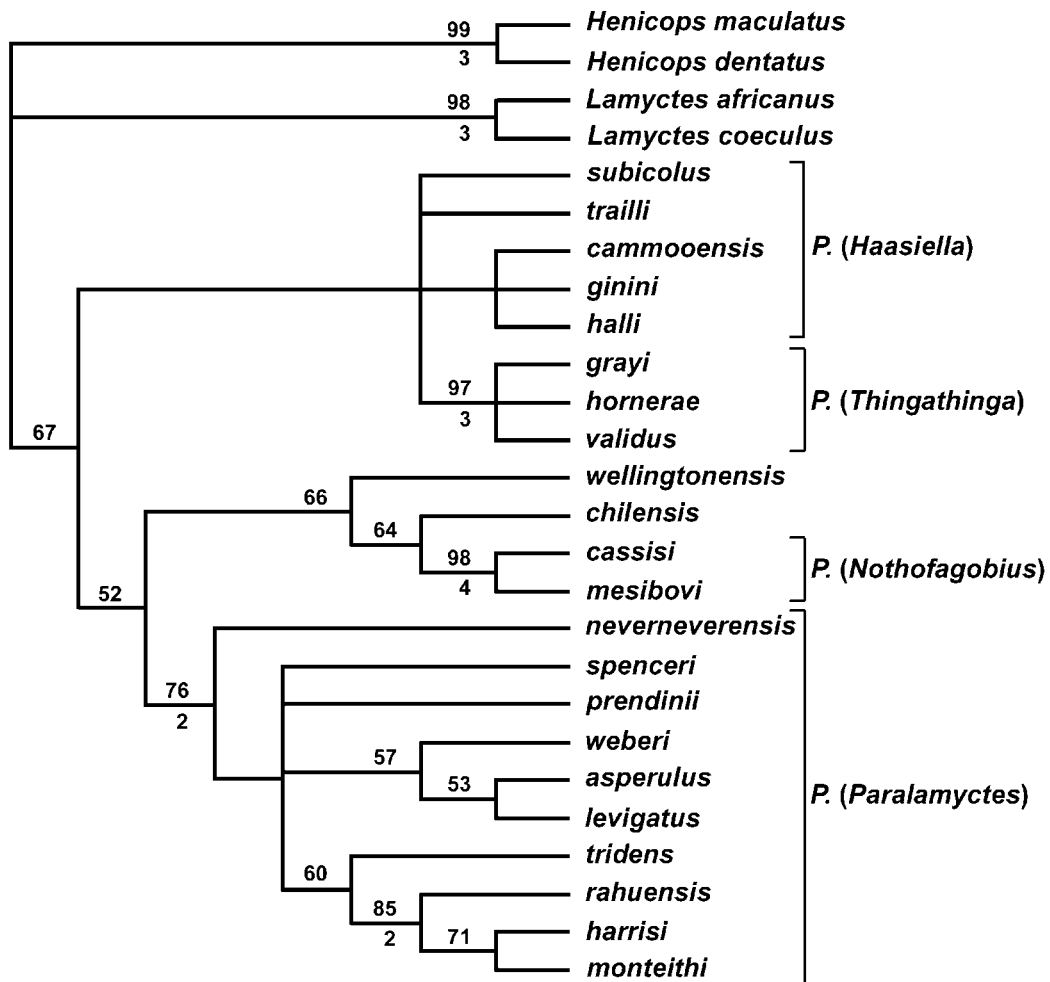


FIGURE 32. Strict consensus of 12 shortest cladograms for *Paralamyctes* and outgroups based on morphological data in Table 1. Numbers above nodes are jackknife frequencies greater than 50%. Numbers below nodes are Bremer support values greater than 1.

The positioning of the Tömösváry organ on the margin of the head (character 3, state 1) is optimised on the cladogram in Fig. 32 as a synapomorphy for the Malagasy *P. (P.) tridens* and an Australasian clade composed of *P. (P.) rahuensis*, *P. (P.) harrisi* and *P. (P.) monteithi*.

monteithi. Apomorphic characters for the *rahuensis* + *harrisi* + *monteith* clade (present in 85% of jackknife replicates; Bremer support of 2) are an elongation of the antennal articles (character 2: Fig. 11), a shouldered labral margin (character 5), and distal spinose projections on the tibia of leg 14 (character 23, state 3). The new species, *P. (P.) rahuensis*, is distinguished from both *P. (P.) harrisi* and *P. (P.) monteithi*, which unite as sister species, by its fewer setae on the apex of the coxal process of the first maxilla (Fig. 25), denser hair-like branches on the ventral bristles in the mandibular fringe (Fig. 29), and subquadrate rather than subsemicircular maxillipede coxosternite (Fig. 16), with a straighter dental margin (Fig. 19). It is further distinguished from the North Island species *P. (P.) harrisi* by its larger number of maxillipede teeth (4+4 to 5+5 versus 2+2 or 3+3 in *P. harrisi*), and fewer setae on the coxosternite of the second maxilla (Fig. 15), which is exceptionally setose in *P. harrisi* (as many as 25 setae per coxa). The anterolateral part of the maxillipede coxosternum is also more setose in *P. (P.) harrisi* (Archey 1937: pl. 20, fig. 5; Edgecombe et al. 2002, fig. 3H) than in *P. (P.) rahuensis*. Additional distinction from *P. (P.) monteithi* is made based on the anterior accessory claw being based on the dorsolateral side of the main claw in *P. (P.) rahuensis* (Fig. 22) versus a more ventrolateral base of the accessory claw in *P. (P.) monteithi*.

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1. Convexity of ocellus: (0) bulging; (1) flattened.
2. Long, tubular antennomeres: (0) some articles equally wide and long, proximal two articles much longer than succeeding few; (1) all articles longer than wide, proximal two articles not substantially larger than succeeding few.
3. Tömösváry organ on margin of head: (0) Tömösváry organ opening on surface of cephalic pleurite; (1) Tömösváry organ in membranous field on ventral margin of head.
4. Median furrow on head shield: (0) terminating in front of transverse suture; (1) deep and continuous to transverse suture.
5. Shoulder in labral margin: (0) absent; (1) present.
6. Shape of maxillipede coxosternum: (0) subtriangular with narrow, curved dental margin; (1) subtrapezoidal with narrow, straight dental margin; (2) semicircular; (3) trapezoidal with narrow curved dental margin; (4) wide, subtransverse dental margin; (5) narrow, straight dental margin, projected forward; (6) wide, gently convex margin with shallow V.
7. Maxillipede teeth progressively decreasing in size medially: (0) absent; (1) present.
8. Proportions of maxillipede tarsungulum: (0) pretarsal section of approximately equal length to tarsal section; (1) pretarsal section much longer than tarsal section.
9. Dense setation on inner part of maxillipede tibia and femur: (0) absent; (1) present.
10. Body narrowed across anterior part of trunk: (0) T1 of similar width to head and T3; (1) T1 narrower than head and T3.
11. Angulation (projections) of posterolateral corners of tergites: (0) some angular or toothed; (1) all rounded.
12. Posterior margin of T7 embayed, with median sector straight: (0) absent; (1) present.
13. Course of posterior margin of T8: (0) concave; (1) transverse.
14. Row of distally-pointed, digitiform pinnules confined to dorsal margin of aciculae: (0) absent; (1) present.
15. Aciculae exclusively simple: (0) absent (pinnulate aciculae present); (1) present.
16. Aciculae divided into two (outer and inner) rows: (0) single row; (1) two rows.
17. Grooved ridge in field of accessory denticles on mandible: (0) accessory denticles interrupted by grooves running along teeth; (1) continuous field of accessory denticles, without grooved ridges.
18. Accessory denticles on dorsal part of mandible: (0) simple, triangular denticles; (1) flattened, multifurcating scales.
19. Furry pad intergrades with accessory denticles: (0) absent; (1) present.
20. Shape of first maxillary sternite: (0) small, wedge-shaped, with median suture; (1) large, bell-shaped, coxae not merged anterior to sternite, suture between coxa and sternite confined to posterior edge of maxilla.
21. Setae on coxal process of first maxilla: (0) mostly simple setae; (1) several laciniate or

- plumose setae amidst simple setae.
22. Coxal pores set in deep cuticular fold, largely concealed in ventral view: (0) absent; (1) present.
 23. Distribution of distal spinose projections on tibiae: (0) last strong spur on leg 11 (weak projection on leg 12); (1) last strong spur on leg 12; (2) last strong spur on leg 13; (3) last strong spur on leg 14; (4) last strong spur on leg 15.
 24. Articulation on tarsus of legs 1–12: (0) strong articulation between tarsomeres; (1) weak or indistinct articulation between tarsomeres.
 25. Articulation between basitarsus and distitarsus in anterior pairs of trunk legs: (0) distinct on dorsal side of leg; (1) fused on dorsal side of leg and distinct ventrally.
 26. Tripartite tarsus on legs 1–12 (bisegmented basitarsus): (0) absent; (1) present.
 27. Insertion of anterior pretarsal accessory claw: (0) dorsolaterally on main claw; (1) ventrolaterally on main claw.
 28. Length of posteroventral spine on pretarsus (leg 14): (0) short (less than one-fifth length of main claw); (1) long (more than half length of main claw).
 29. Definition of scutes on pretarsal accessory claws: (0) absent or weak; (1) strong.
 30. Definition of scutes on dorsoproximal part of main pretarsal accessory claw: (0) distinct; (1) indistinct.
 31. First genital sternite of male divided longitudinally into two sclerites: (0) undivided; (1) divided.
 32. Number of spurs on female gonopod: (0) two; (1) three.
 33. First article of female gonopod extended as a short process: (0) absent; (1) present.

TABLE 1. Codings for 33 morphological characters listed in Appendix.

<i>Henicops dentatus</i>
0000010000 0100010000 1030110000 100
<i>Henicops maculatus</i>
0000010000 0000010000 1030110000 100
<i>Lamyctes africanus</i>
0000000000 1000000100 0011-00100 100
<i>Lamyctes coeculus</i>
-0000000000 1000000100 0001-00100 ?00
<i>Paralamyctes asperulus</i>
0001030100 0101000011 0020001000 000
<i>Paralamyctes cammoensis</i>
1001031000 1010000001 0011-00000 000
<i>Paralamyctes cassisi</i>
0001030001 0000101001 0040000000 011
<i>Paralamyctes chilensis</i>
0001030001 0000000001 0030000000 001
<i>Paralamyctes ginini</i>
1001030000 1010000001 0011-00000 000
<i>Paralamyctes halli</i>
0001031000 1010000001 0021-00000 000
<i>Paralamyctes harrisi</i>
0111120110 0001000011 0030000000 000
<i>Paralamyctes hornerae</i>
1001140100 0100100001 00?1-00011 000
<i>Paralamyctes levigatus</i>
0001040100 0101000011 0030001000 000
<i>Paralamyctes mesibovi</i>
0001030001 0000101001 0040000000 011
<i>Paralamyctes monteithi</i>
0111120110 0001000011 0030001000 000
<i>Paralamyctes neverneverensis</i>
0001030000 0001000011 0040000000 000
<i>Paralamyctes prendinii</i>
0000060100 0001000011 0020000000 000
<i>Paralamyctes rahuensis</i>
0111140100 0001000011 0030000000 000
<i>Paralamyctes spenceri</i>
0001030100 0001000011 0020000000 000

Paralamyctes subicolus

1001041100 0010000001 0031-00000 000

Paralamyctes trailli

-001051100 0010000001 0021-00100 000

Paralamyctes tridens

0011020100 0001000011 0020000000 000

Paralamyctes weberi

0001030100 0001000011 0030001000 000

Paralamyctes wellingtonensis

0001030000 0000000001 0030000000 001